

# Cross-Subsidization in Telecommunications<sup>1</sup>

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## Abstract

The Telecommunications Act and FCC and state commission orders have made the proper consideration of cross-subsidization increasingly important. This article briefly surveys the economics literature on cross-subsidization. Caveats regarding the application of the theory to telecommunications, including cross-elastic effects, zero economic profit assumptions, and mistaken identification of loop costs as common production costs, are discussed. The patterns of cross-subsidy and claims of their existence in the industry are considered. The FCC's recent orders are discussed in the context of the relevant economics literature.

## 1. Introduction

The federal Telecommunications Act of 1996 (the Act) contains eight separate references to the terms "subsidy" or "cross-subsidy." These terms appear in the Act regarding the following: manufacturing by Bell Operating Companies; universal service; provision of telemessaging service; electronic publishing; alarm monitoring services; provision of payphone service; and availability of equipment used to access services provided by multichannel video programming distributors.<sup>2</sup> In seven of these eight instances, the intent appears to be to establish rules and practices that would preclude a Bell Operating Company from subsidizing competitive activities through noncompetitive sources. However, while the Act uses the word "cost" over thirty times, there is no mention of the terms "incremental" or "stand-alone."

The Act establishes the Federal Communications Commission's (FCC's) responsibility in producing three key orders that are drastically changing the telecommunications industry. The FCC (1996) local competition order, while not dealing with cross-subsidization explicitly, utilizes incremental cost terminology in its sections regarding costs and pricing of

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1 The author is grateful to Dino Falaschetti and Chris Graves for their research assistance. An earlier version of this paper was presented at the 9th Annual Western Conference of the Advanced Workshop in Regulation and Public Utility Economics, July 1996, where the discussants and the audience provided useful comments. Two anonymous referees provided very valuable comments.

2 The Telecommunications Act of 1996, SECs. 273 (g), 254 (k), 260 (a), 274 (b)(4), 275 (b)(2), 276 (a), and 629 (a) respectively.

unbundled network elements. The FCC (1997(a)) order regarding universal service uses variants of the term "subsidy" approximately sixty (60) times. One of the central themes of the order is the need to modify past patterns of cross-subsidies in telecommunications. It states, for example:

The Act [The 1996 Telecommunications Act] also recognizes, however, that universal service cannot be maintained without reform of the current subsidy system. The current universal service system is a patchwork quilt of implicit and explicit subsidies. These subsidies are intended to promote telephone subscribership, yet they do so at the expense of deterring or distorting competition (FCC 1997(a), 5).

The FCC (1997(b)) order regarding access charge reform establishes the third leg of the new policy stool. This order complements the universal service order by reducing one of the most important sources of contribution to support basic local exchange service: per-minute switched access charges paid by interexchange carriers (IXCs).

A large number of proceedings dealing with local competition, universal service and access charge reform (and other forms of rate rebalancing) have appeared and continue to appear at the state level. These recent significant changes in regulatory policy, at both the state and federal level, make the proper evaluation of cross-subsidization increasingly important. In particular it is useful to consider the extent to which economic theory has been, and can be, applied to the policy debate.

In section 2, the early (before 1975) literature on cross-subsidization is briefly reviewed. Section 3 examines the formalization of the theory, which occurred largely between 1975 and 1982, on subsidy-free pricing, consumer subsidy-free prices, and anonymous equity. Section 4 discusses caveats and issues in the application of the theory, especially application to the telecommunications industry. Claims of cross-subsidization in telecommunications are reviewed in section 5, and actual estimates of such cross-subsidies are considered in section 6. Section 7 considers the proper treatment of loop costs in evaluation of local subsidies. Loop costs are shown to be part of the cost of access to the telecommunications network rather than common production costs to the Local Exchange Company (LEC). It considers the relevance of the economic constructs of subsidy-free pricing to the three key FCC orders on universal service, access reform, and local competition. Section 8 also discusses the cost proxy models that are currently under review by the FCC and which may form the basis of future evaluations of cross-subsidies. Section 9 provides a brief summary and conclusion.

## 2. The Early Literature<sup>3</sup>

The phrase "cross-subsidization" is sometimes used in business to simply refer to circumstances where contribution margins across products or brands are not equivalent or a product's contribution is not constant over its life cycle.<sup>4</sup> This casual business usage does not imply an activity that is necessarily inefficient or anticompetitive and this less formal

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3 Useful descriptions of at least parts of this literature are contained in Mitchell and Vogelsang (1991, 118-136); Zajac (1995, 205-13); Faulhaber (1979); Baumol (1987, 111-130); Laffont and Tirole (1993, 173, 202-3); Palmer (1989(a)); and Spulber (1989, 120-7).

4 See, e.g., Lofthouse (1978, 58).

terminology and business literature will not be treated further. Discussions of cross-subsidization or internal subsidization have also existed in the economic literature for many years.<sup>5</sup> Part of this early work considered cross-subsidization as a form of financing predatory prices. Corwin Edwards was an early proponent of this position contending that "low prices in some markets are only profitable if they are offset by higher prices in other markets" (1949, 20).<sup>6</sup> However, most modern economists dismiss the notion of concurrent profits and losses;<sup>7</sup> an activity or investment should be rational or profit-improving regardless of the source of funding.

In a seminal article, Averch and Johnson (A-J)<sup>8</sup> (1962), describe what they believe are the implications of their model of a regulated firm receiving a return on capital greater than the market return. They state:

The firm has an incentive to expand into other regulated markets, even if it operates at a (long run) loss in these markets; therefore, it may drive out other firms, or discourage their entry into these other markets, even though the competing firms may be lower-cost producers (1962, 1059).

Economists have generally focused on the "overcapitalization" implication rather than on the "cross-subsidization" implication of the A-J model.<sup>9</sup> The cross-subsidization effect is less robust (as compared to the overcapitalization effect) for three reasons: 1) the cross-subsidization implication is based on a simple formulation which implicitly appears to rely on the existence of an overcapitalization bias;<sup>10</sup> 2) unlike the overcapitalization bias, the size of the cross-subsidization effect appears to be limited by the size of the differential  $s-r$ ;<sup>11</sup> and 3) although Averch and Johnson state that "a large element of common costs" may exist for the industry, they do not appear to recognize that the existence of common costs would make unprofitable expansions less likely.<sup>12</sup>

Writing at about the same time as Averch and Johnson, Wellisz (1963) presents a model of peak and off-peak provision of natural gas pipeline service by a company subject to "fair return" constraint. He concludes that the regulated firm would price off-peak service above its opportunity cost and simultaneously price peak service below its opportunity cost. While Wellisz does not use the terms subsidy or cross-subsidy, he essentially concludes that the

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- 5 See e.g., Baumol (1987, 112 citing Hadley (1886)); Alexander (1887); Ackworth (1891); and Lewis (1949). Baumol does not suggest that these sources use the terms cross-subsidy or internal subsidy but rather that they discuss conceptual foundations of what might now be called the burden test.
  - 6 See also U.S. Federal Trade Commission (1969, 420) (discussing cross-subsidy as a method of funding predatory pricing); and more recently Loescher (1980).
  - 7 See, e.g., Brooks (1961, 797). Additionally, Baumol suggests that "(f)or a firm that is unregulated and whose objective is maximization of profits this cross-subsidy story makes no sense" (1987, 112). See generally Parsons (1982).
  - 8 Models of this type are sometimes referred to as A-J or A-J-W which also recognizes the article by Stanislaw Wellisz (1963, 30-43).
  - 9 Empirical testing of the A-J model has almost exclusively focused on the overcapitalization implication rather than the cross-subsidy implication.
  - 10 "(T)he regulated firm in this example finds market 2 attractive because it can add capital to the rate base at no loss" (Averch and Johnson 1962, 1059).
  - 11 Averch and Johnson (1962, 1059) denote the regulatory constraint or maximum allowed return on capital by  $s$  and the cost of capital by  $r$ .
  - 12 See Averch and Johnson (1962, 1065) discussing returns to scale but implicitly ignoring economies of scope.

regulated firm has an incentive to cross-subsidize peak service.<sup>13</sup> However, this result appears to be contingent on the inability of the firm to substitute capital for other inputs. Within the Wellisz model the only opportunity to increase the capital base is to lower the price of peak service in order to cause a greater need for pipeline capacity. What appears to be an incentive to cross-subsidize may only be an indirect means to overcapitalize.

Elizabeth Bailey, in considering a richer A-J two-product or two-market model, concludes that "[h]ence, the existence of the single constraint extending over both markets need not introduce inefficiency in output proportions" (1973, 85). In other words, there is not an incentive to cross-subsidize entry into a second market.<sup>14</sup> In contrast, she does find an incentive for the more well-known A-J overcapitalization effect (Bailey 1973, 85). Her finding suggests that the Wellisz model likely reflects an indirect method of overcapitalization rather than an incentive to cross-subsidize *per se*.

Similarly, William Brock (1983, 191), in utilizing a model which explicitly accounts for fixed and common costs faced by a rate-of-return regulated firm, finds: "[i]t [the analysis in the chapter] shows that regulated firms are not more likely to engage in predatory R&D programs and predatory cross subsidization than unregulated firms." William Brock and David Evans, relying in part on a more simple analysis than that used by Brock (1983), conclude: "In fact, the proposition that a regulated firm has a greater incentive to indulge in predatory cross-subsidization than an unregulated firm is false under plausible assumptions concerning the regulatory process" (1983, 55).

Alfred Kahn, in his two volume work (1970(a), 1970(b)), although apparently not relying on a formal model, captured much of the essence of both the incremental and the stand-alone cost tests (discussed in the subsequent section in more detail). In a discussion of cream-skimming, Kahn (1970(b), 221) states: "the question is whether the carrying of the less remunerative business is a burden on the regulated company in its competition with allegedly cream-skimming interlopers."<sup>15</sup> He provides a similar insight in a discussion of the proper limits on discrimination.<sup>16</sup> He also states, again in the context of cream skimming: "[t]he correct economic answer is that no class of customers should be required to pay more than the total cost of serving it alone" (Kahn 1970(a), footnote 9 at 222).

Apparently relying on experience in regulated industries rather than a formal model, Richard Posner (1971) considers "internal subsidization" or "cross-subsidization" at length. He captures the essence of the incremental cost test when he suggests that this occurs when "a service is provided that does not pay its way in the market" (1971, 24). He also appears to imply the notion of the stand-alone cost test.<sup>17</sup> Posner (1971, footnotes 15 and 16 at 24)

13 While one may be tempted to consider cost of the pipeline as a common cost to the provision of both peak and off-peak services, the assumptions employed by Wellisz are tantamount to assuming that requirements for capacity expansions are strictly caused by peak usage.

14 "[T]he rule used equates the additional revenue per dollar spent in market 1 with that of market 2" (Bailey 1973, 85).

15 Kahn (1970, 221) also states that "[i]f it is not a burden, the cream skimming case for protection can be clearly rejected. This will be the case as long as the less remunerative business covers its own marginal costs." See also Zajac (1995, 206) citing William J. Baumol, Otto Eckstein, and Alfred E. Kahn (1970).

16 "[A]s long as the favored customers pay their full additional costs, the others cannot on this account be led to pay more than the costs of serving them in the absence of discrimination. And both together imply the condition that discrimination be permitted only as long as it imposes no burden on the customers being discriminated against. Such a rule would prohibit internal subsidization" (Kahn 1970(a), 142-3).

17 "Prices in certain markets must exceed costs if the losses sustained in providing the subsidized services

suggests that "internal or cross-subsidization, as we may call the practice, lie everywhere at hand in the regulated industries," and "are commonly found among public enterprises here and abroad."<sup>18</sup>

### 3. Development of the Theory Since 1975

The first rigorous published treatment of cross-subsidization is presented by Gerald Faulhaber (1975), who explicitly defines subsidy-free pricing and presents two tests for cross-subsidization.<sup>19</sup> Faulhaber models the multiproduct firm (producing efficiently with cost subadditivity and facing a zero economic profit constraint) and the consumers of its services as a cooperative game. He specifies the incremental cost test (inequality 1 below) as satisfied if the revenue from any quantity of service or subset of services  $s$  is greater than or equal to the change in total cost caused by not producing the service or subset of services (1975, 969).<sup>20</sup> The change or increment in cost is the difference in total cost with and without the subset of services. This guarantees that the service or subset of services  $s$  does not receive a cross-subsidy. The vector of prices leading to such revenues are considered to be subsidy free if (1) is satisfied for all integers  $s$  less than  $n$ , where  $n$  is the total number of services produced by the firm.

$$R(q^s) \geq [C(q^n) - C(q^{n-s})] \quad (1)$$

Faulhaber also defines the stand-alone cost test as requiring that the revenue from a service or subset of services be less than or equal to the cost of providing that service or subset of services independently (inequality 2 below). When satisfied, one can consider that the service or subset of services  $s$  does not *provide* a cross-subsidy. As with the incremental cost test, the vector of prices leading to such revenues are considered to be subsidy free if (2) is satisfied for all integers  $s$  less than  $n$ .

$$R(q^s) \leq C(q^s) \quad (2)$$

The two tests are equivalent or dual in the absence of diseconomies of scope and the presence of efficient production and a zero economic profit constraint; one need only test all service combinations with one test, either the incremental cost test or the stand-alone test. The existence of economies of scope, in some sense, creates a range of subsidy free prices between incremental and stand-alone costs or a core to the cooperative game.<sup>21</sup>

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are to be recouped" (Posner 1971, 34).

18 Posner (1971) cites the following: Transportation Act Amendments (1962); Bonbright (1961, 111-2); Friedlaender (1968, 66-8); Garfield and Lovejoy (1963, 225); Hirshleifer, DeHaven, and Milliman (1960, 109-11); Meyer, Peck, Stenason, and Zwick (1959, 194-5); Nelson (1959, 331); Sharp (1967, 53); Baratz (1962, 305); Coase (1955, 25); Coase (1950, 11-4); Crew (1968, 258); Kennedy (1957, 93-94); Nove (1969, 847); Peltzman (1971, 109-147); Sargent (1963, 248); Shepherd (1964, 132); and Keig, Fristoe, and Goddard (1970).

19 As early work in the area, Faulhaber cites Zajac (1972).

20 Faulhaber (1975, 974-76) begins with a model assuming independent demand but expands the analysis later to include non-zero cross-elasticities. Although he does not use the term "net incremental cost test," he has clearly laid the groundwork for such a test in the later portion of his article.

21 The "core" here is the range of prices which are subsidy-free or the range over which the cooperative game has a solution. Faulhaber appears to recognize that the core is larger with the existence of

Faulhaber considers a game played only in a product or service dimension. Sharkey and Telser expand the analysis to examine consumption bundles and modify the stand-alone cost criterion to consider a supportable cost function and "consumer subsidy-free prices" as those for which there is no coalition of consumers (at current demand quantities) which could provide services to themselves at a cost less than revenues expended (1978).<sup>22</sup> In strict inequality (3), the supportable vector of prices  $p$  corresponds to the quantity vector  $q$  for which no consumption bundle satisfies (3) below (where  $q^*$  is a consumption bundle subset of  $q$ ). The cost function  $C(q)$  is supportable if a supportable vector  $p$  exists.<sup>23</sup>

$$C(q^*) < p'q \quad (3)$$

This more stringent test precludes the existence of significant product-specific diseconomies of scale that might cause service prices to be subsidy free but not consumer subsidy free.<sup>24</sup> Sharkey and Telser move the focus from services, utilized by Faulhaber, to coalitions of customers and the services and service quantities that would be consumed by coalitions. Faulhaber and Levinson define anonymous equity as consumer subsidy-free prices (support prices) that yield quantities consistent with demand functions (1981, 1983). They demonstrate that the incremental cost test in combination with consumer demands that only vary by a scaling factor insures anonymous equity (1981, 1983).<sup>25</sup> This more rigorous concept requires that prices are subsidy free, support prices, and consumer subsidy free. There will be no coalition that could produce its service quantities at costs lower than payments generated by the prices under anonymous equity. Note that anonymous equity, like the work by Sharkey and Telser, utilizes the more expansive concept of examining service quantities as the dimension of analysis. Sharkey (1982) examines consumer welfare under conditions of monopolistic supply versus self-supply. Like the other models, Sharkey includes the essence of a zero profit constraint in a net benefit condition, and he models a cooperative game. However, unlike Faulhaber (1975), Sharkey allows side payments between coalition members in establishing conditions that represent a subset of subsidy-free prices.

Karen Palmer (1989(a), 1989(b), and 1991) describes an alternate set of tests for circumstances in which non-complementary services exist. She uses a two-product model and an alternate definition of product-specific scale economies developed by Baumol, Panzar, and Willig (1982), to produce modified strict inequality incremental cost tests that utilize revenue data, estimates of the total joint costs of production, and marginal cost estimates. Palmer's tests do not require observations on stand-alone costs *per se*, but rather establish an upper bound for stand-alone costs that equals stand-alone costs in the absence of product-specific scale economies. Perhaps more importantly, even when economic profits do not equal zero,

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complements in consumption and smaller in the presence of substitutes in consumption (1975, 975). Consider a simple example with two services produced in fixed proportions. Service "basic" has an incremental cost of \$25 as does service "vertical" and the firm has joint costs of \$50. Here the subsidy free range of prices for both basic and vertical is between \$25 and \$75; with zero economic profit the price of vertical = \$100 - (price of basic)  $\geq$  \$25.

<sup>22</sup> See also Sharkey (1982).

<sup>23</sup> A vector  $p$  need not be unique.

<sup>24</sup> At least it precludes the existence of service-specific diseconomies which are not dominated by the service-specific economies of the other services within the bundles which consumers demand.

<sup>25</sup> See also ten Raa (1983, 176) discussing other cost and demand characteristics which are sufficient to produce anonymous equity.

Palmer provides a sufficient set of conditions to determine the existence of a cross-subsidy.

#### 4. Caveats in Applying the Theory

##### 4.1. Caveats

Violation of the stand-alone cost test is sometimes described as creating entry-inducing prices; however, one of the more vexing results in the literature on cross-subsidization and sustainability is that certain (and in some instances all) vectors of prices that are subsidy free may not be sustainable in the market.<sup>26</sup>

A practical issue is the applicability for regulated utilities of two of the major assumptions of the Faulhaber model: efficient production and a zero economic profit constraint. The traditional rate-of-return regulated firm may not choose cost minimizing input combinations or production techniques. In practice, such effects may be mitigated by incremental cost estimation techniques designed to reflect efficient production and least cost technology choices.<sup>27</sup>

Part of the importance of the zero economic profit constraint is that it is necessary for the duality of the incremental cost and stand-alone cost tests (i.e., that one or the other set of tests need be performed, but not both). However, the zero economic profit constraint may not be satisfied under modern incentive regulation or price-cap plans or even under traditional rate-of-return regulation when regulatory lags are long. Under incentive regulation or price-cap plans, any divergence in economic profit away from zero is likely to have resulted from cost reductions and improved efficiency in production. In other words, incentive regulation may make the zero economic profit assumption less reasonable while simultaneously making the efficient production assumption more reasonable. On balance, the Faulhaber model may be no more, or less, applicable under incentive regulation/price caps than under traditional rate-of-return regulation.

Cross-elastic demand conditions also complicate the application of the Faulhaber tests. In practice, one might interpret the expression  $R(q^s)$ , from inequality (1), as the revenue that is directly generated by the services  $q^s$  (i.e., without accounting for cross-elastic revenue effects). With such an interpretation, if services are substitutes, then the incremental cost test becomes a necessary, but not sufficient, condition for subsidy-free pricing.<sup>28</sup> Conversely, with such an interpretation, if services are complements, the incremental cost test becomes a sufficient, but not necessary, condition for subsidy-free pricing.

Even assuming independent demand functions, the Faulhaber conditions require that all combinations of services ( $s$ ) for  $s \leq (n-1)$  be tested to ensure a vector of subsidy free prices. The number of combinations of tests (and the number of cost estimates required) becomes impracticably large (in the millions) for the number of services offered by a typical Local Exchange Company (LEC). In telecommunications, incremental cost calculations by incumbent LECs are relatively common although they are almost always limited to the estimation

26 See, e.g., Faulhaber (1975). See also Zajac (1972) providing an example of Ramsey-efficient prices which do not pass an incremental cost test. A more complete discussion of sustainability is beyond the scope of this article.

27 See the discussion of proxy models in section 8 of this article. See also Kahn and Shew (1987, 229-232) discussing the issue of least cost production overall and concepts of forward looking costs generally.

28 See Palmer (1991), Faulhaber (1975), Faulhaber and Levinson (1981) and Sharkey (1982).

of the costs of providing a single product or service rather than the costs of providing some combination or subset of the total services of the firm. In addition, stand-alone cost estimates are rarely attempted and generally considered to be impractical or hypothetical in nature.

One should interpret the existing single-service incremental cost estimates produced by LECs as establishing the lower-bound price for a service that precludes that service from receiving a cross-subsidy.<sup>29</sup> This interpretation is correct regardless of whether the firm earns a zero economic profit.<sup>30</sup> Existing LEC studies are not sufficient to determine whether the full vector of prices are subsidy-free. The missing residual information is the degree to which the shared costs of groups or families of services are covered by revenues from such groups and services. To the extent that costs which are not incremental to individual services are genuinely common to all services, cross-subsidy tests for groups of services are less important. Conversely, to the extent that costs that are not incremental to individual services but are caused by families of services, tests of such families are more important.

#### 4.2. Applying Net Versus Gross Tests

William Baumol may have been the first to discuss a "burden test."<sup>31</sup> Later, Baumol (1987, footnote 2 at 119) defines the net incremental cost test (alternatively described as the burden test or net revenue test) as the cross-subsidy test allowing for nonzero cross elastic effects.<sup>32</sup> He also defines the gross incremental cost test as one which ignores any cross-elastic effects and suggests that the net incremental cost test is the "appropriate criterion for intercustomer fairness while the same can be said for the incremental cost test [the gross test] in relation to fairness to competitors" (Baumol 1987, footnote 2 at 119). Baumol's discussion in this regard is troubling for three reasons. First, one may improperly interpret his burden test as a comparison of net incremental revenues (including cross-elastic effects) with gross incremental costs rather than net incremental costs, where the difference is the cost of the increment in quantity of cross-elastic services (1987, 117-9).<sup>33</sup> Second, the fairness to competitors standard appears to implicitly ignore or preclude side payments between firms or other contractual relationships to account for more efficient production by a stand-alone (some  $n$ -1 product) producer.<sup>34</sup> Third, the gross test does not appear to be consistent with the Efficient Components Pricing Rule (ECPR, advanced by Baumol and Sidak (1994(a), and 1994(b))). The ECPR, and the conceptually equivalent full-opportunity cost imputation standard can be considered as a test of fairness to competitors, yet it is clearly a form of a net test.<sup>35</sup> Baumol does not advance a test, nor does one exist in the literature, for fairness

29 This assumes a uniform single-part price when the demand for that service is independent of the demand for all other services offered by the firm. However, multipart pricing interpretations are possible; this issue is discussed later in the article.

30 The zero economic profit assumption is required for a determination of whether the firm's full vector of prices is subsidy-free, but it is not required for the statement of this necessary condition.

31 See Faulhaber (1979, 104) citing FCC (1970). It is not clear from the cite whether the term "incremental revenue" is intended to account for interdependent demand (i.e., cross-elastic) effects.

32 See also Larson (1991, 319); and Palmer (1989(a), note 4).

33 For example, "The Pareto improvement criterion as used to judge equity among customer groups clearly requires a comparison of the net IR of I with its IC; i.e., it requires the burden test" (Baumol 1987, 119). Also, a numerical example suggests that Baumol (1987, 117) intends to compare net incremental revenues with gross incremental costs. This may simply be a numerical or typographical error; this position seems incompatible with the other literature in the area.

34  $N$  is the number of products of the incumbent and  $I$  is any integer less than  $n$ .



to incumbents.

Baumol (1987, footnote 2 at 117) also considers examples of increasing marginal cost and states "[t]he question, then is whether some sort of fairness consideration requires price to exceed marginal cost as well as average incremental cost for every relevant quantity increment." While the body of literature on subsidy-free pricing does not explicitly discuss multipart pricing, it is clearly not precluded.<sup>36</sup> It may be possible to incorporate multipart pricing into the original Faulhaber test simply by relaxing the definition of a "service."<sup>37</sup> There may also be opportunities for further research by integrating the literature on optimal multipart pricing with the cross-subsidization literature.

## 5. Claims of Cross Subsidy in Telecommunications

The economics literature has several examples of statements regarding the existence of cross-subsidies in the telecommunications industry. Kaserman and Mayo suggest that there are four patterns of cross-subsidization that have tended to exist in the industry: 1) toll to local; 2) business to residence; 3) low usage to high usage; and 4) urban to rural (1994, 119, 131). Nicholas Curien recognizes three of these four patterns of cross-subsidization as existing outside of the United States.<sup>38</sup> These relationships are also frequently discussed by economists in regulatory proceedings.<sup>39</sup>

The toll-to-local subsidy has received the greatest attention. Peter Temin provides a historical perspective on the toll-to-local cross-subsidization debate and states: "I conclude that local telephone service continues to receive a cross subsidy from interexchange service" (1990, 349). Earlier, Alfred Kahn concluded: "These inefficient pricing practices are the consequence and instrument of a complex network of cross-subsidies between different customer groups. First, long-distance service under the present system grossly subsidizes local service" (1984, 139, footnote 2 at 143).

Leland Johnson (1992) provided an early and thorough examination of the costs and revenues of toll and local access. He found that "[o]n a nationwide average, the monthly subscriber line cost for the Bell system averages \$26, while the average residential telephone rate (including some local calls) is about \$10" (Johnson 1992, xi). Johnson (1992, xi, 60) also states: "we find that in 1981 interstate MTS and WATS covered about \$7 billion of the costs of 'non-traffic sensitive' plant" (which he estimates accounted for \$7 of the \$26 cost of local service). Johnson concluded "[b]ut today most residential subscribers pay much less than cost. ... [a]ccess to the network by those who make few or no long-distance calls is subsidized by others who, heavily dependent on interstate service, pay many times their subscriber line cost."<sup>40</sup> Kaserman and Mayo (1994, footnote 1 at 132) state that: "[e]cono-

35 See also Larson and Parsons (1994) and Larson and Parsons (1993, 16).

36 "More appropriately, SAC is a revenue ceiling rather than a price ceiling" (Larson and Meitzen 1992, 135).

37 "Relaxing" the service definition is something of a misnomer. The cross-subsidy literature does not explicitly define a service so as to preclude the approach discussed here.

38 "This study shows an empirical estimate of traditional expectations of subsidy from toll to local, from business to residence and from urban to rural" (Curien 1991, 102).

39 See, for example, Baumol, Ordover and Willig (1996, 8) stating: "Cross-subsidies are common in the rate structure, and rates depart systematically from pertinent costs".

40 See Johnson (1982, 69) who identifies the portion of nontraffic sensitive costs assigned to MTS and WATS in 1981 as "about 14 cents per minute of use."

mists have long maintained that the historic practice of allocating the fixed costs of the network to the long-distance market has resulted in a significant cross-subsidization of the access/local service bundle, resulting in local flat rates that fall far short of the costs of providing the combined services."

The toll-to-local subsidy issue is considered by John Wenders who, in his 1987 book, states: "[t]hus, prices do depart from marginal cost significantly in the telecommunications industry—they are too high in toll and too low in the residence local market—and therefore corresponding subsidy flows exist in this industry" (1987, 177). Egan and Weisman (1986), Faulhaber (1987, 89), and Maher (1993) note this form of cross-subsidization as well.<sup>41</sup> Richard Vietor (1989) suggests that the size of the local subsidy may have been fueled by a period of increasing costs for local while costs for toll fell.<sup>42</sup> Hausman et al. (1993) contend that while the local subsidy may come largely from toll services it is derived from other sources as well.<sup>43</sup> And Curien (1991) as well as Globerman and Kadonaga (1994) discuss the existence of a toll-to-local subsidy outside of the United States.<sup>44</sup>

It is widely accepted in the telecommunications industry, that urban areas (*vis-à-vis* rural areas) tend to have higher prices but lower costs due to shorter loop lengths and greater density. The urban to rural notion of a pattern of cross-subsidization, discussed by Kaserman and Mayo (1994), is also noted in the 1996 Economic Report of the President:

For many years regulators, with the support of Congress, used cross-subsidies between regulated monopolists to pursue universal service goals. Through a complicated nationwide pooling of telephone costs and revenues, local telephone companies especially in high-cost rural areas, received substantial subsidies to keep their rates low....There may also have been subsidies from business to residential customers (Economic Report of the President 1996, 177).

Curien (1991) finds that even with a single price across urban and rural areas, a cross-subsidy may exist because of the cost differentials between the areas.<sup>45</sup> Curien (1991,

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41 "Prior to divestiture ... long distance service was priced substantially above costs in order to subsidize local service. ... Under the present scheme, rates for long distance users, especially high volume users, cover a disproportionate share of the fixed costs for the local network" (Maher 1993, 1-2).

42 "Similarly, the system of cross-subsidies so recently established to equalize prices between local and long-distance services came under increasing pressure. As Chart 2-7 shows, the new technologies in transmission and switching dramatically lowered the costs of long-haul interexchange services but scarcely slowed the rising costs of the local (exchange) loop" (Vietor 1989, 55-6).

43 "At the time of the breakup (and to a lesser extent today) basic access to the telephone network received a large cross subsidy from other telephone services; that is the price of the basic access was well below its incremental (or marginal) cost. The largest component of this cross subsidy arises from the prices of long-distance services which are well in excess of their incremental cost" (Hausman, Tardiff, and Belifante 1993, note 2 at 178).

44 "In telecommunications industries all over the world, the local networks run at a deficit, i.e., connection and subscription charges which are paid by users for their access fail to recover the cost of building and maintaining the connection line and other non-traffic-sensitive equipment" (Curien 1991, 91); "For example, it is widely acknowledged that large numbers of local telephone subscribers, who are disproportionately residential subscribers, are subsidized by a much smaller number of intensive long distance users, who are predominantly large business subscribers. This subsidy takes the form of local rates that are well below economic cost and long distance rates that are well above economic cost" (Globerman and Kadonaga 1994, 129-30).

45 "Economies of scale imply that the per-trunk cost is lower on large routes than on small ones, so that an average price of traffic, based on distance only, will give rise to cross-subsidies" (Curien 1991, 94).

94) provides a study that he claims establishes the existence of business to residence cross-subsidization in France. Palmer (1992, footnote 3 at 415) finds evidence of a business-to-residence cross-subsidy in some wire centers in New England but no evidence of any residence-to-business pattern of cross-subsidization. The existence of a cross-subsidy from business customers to residential customers is also widely (but not universally) noted in unpublished sources. Also, many economists have noted that such subsidies are generally welfare reducing<sup>46</sup> and likely to be unsustainable.<sup>47</sup>

These conclusions are not unanimous. However, counter positions are less voluminous and appear disproportionately in unpublished sources or sources that are not subject to peer review.<sup>48</sup> Many state regulatory commissions have been unwilling to accept the proposition that local service is cross-subsidized.<sup>49</sup>

## 6. Estimates of Cross-Subsidies in Telecommunications

It is generally accepted that business customers pay higher basic local exchange rates than residential customers. In 1995, the average single-line business rate in the United States was \$41.77 while the residential rate was \$19.54.<sup>50</sup> It is also relatively well known that interexchange carrier switched access, intraLATA toll, and vertical services provide high levels of contribution above their respective incremental costs. Kaserman and Mayo (1994, 131) state that "while per unit access charge rates have fallen since the AT&T divestiture, the expanded volume of long distance calling has resulted in access charge payments to local exchange companies of nearly \$20 billion today." And while they find that this revenue measure overstates the contribution stream, the incremental costs of providing interexchange carrier access comprise a relatively small proportion of the price. Monson and Rohlfs (1993) suggest that the contribution from switched access and intraLATA toll "is at least \$18.3 billion but not more than \$21.1 billion." Similarly, Dingwall (1995) states: "[t]elephone subsidies, largely funded by IXC's access charge payments, are estimated to be in the range of \$17.5 to \$20 billion per year."<sup>51</sup> Kahn and Shew (1987, 256) conclude: "[w]hatever the

46 "In fact, the current method of generating the toll-to-local subsidy is grossly inefficient" (Egan and Weisman 1986, 165); "It has been consistently found, not surprisingly, that the current system of rate structures with huge internal cross-subsidies resulted in large deadweight social welfare losses" (Egan and Weisman 1986, 170).

47 "In the end, then, the test of subsidy is usually a test of whether or not economic welfare is being maximized. Thus, prices do depart from marginal cost significantly in the telecommunications industry—they are too high in toll and too low in the residence local market—and therefore corresponding subsidy flows exist in this industry. There is no question that competition will eventually cause this subsidy flow to dry up" (Wenders 1987, 1).

48 See, for example, Lee and Rosquist (1993). Gabel (1995, 453) relies in part on the argument that loop costs are not attributable to local access service, to conclude that local service is not subsidized. See also section 7 on loop costs in this article.

49 For example, the Washington Utilities and Transportation Commission (1996) concludes that the cost of the loop should not be directly attributable to basic local exchange service and, even if it were, US West's incremental cost estimates suggest that basic local exchange service is not subsidized. The Florida Public Service Commission (1987) finds that the price of local exceeded its incremental cost and the Montana Public Service Commission Order (1992) focuses on marginal cost to conclude that local was not subsidized. See also Gable (1995) citing the New Hampshire Public Utility Commission (1991).

50 Federal Communications Commission (1995/1996, 328). These values include subscriber line charges, 911 charges, and taxes.

historic justification for the system of pricing in effect today, it has long since disappeared. Its social cost today is to be reckoned not merely in terms of a multi-billion dollar annual static welfare loss, but ... it has discouraged the exploitation of one of our most dynamic, versatile technologies."

However, estimating cross-subsidies is difficult and public domain studies of cross-subsidies in telecommunications are relatively rare for at least two reasons. First, in the past, incremental costs for residential basic local exchange service were seldom estimated, since they would not have been useful for traditional rate-making purposes. Residential basic local exchange service was residually priced, i.e., it was priced to complete total cost recovery after substantial levels of contribution were derived from other services. With this pricing approach, incremental cost estimates for local service would be irrelevant. And second, incremental cost studies in general, including estimates of the incremental costs of basic local exchange service, have been considered proprietary. However some estimates do exist. A useful review of some of the studies is contained in a presentation by the Telecommunications Industries Analysis Project (Weinhaus 1994).

Palmer (1989(a); 1991) uses a specification of a sufficient set of conditions to test for a cross-subsidy at the local exchange level. In contrast to traditional local exchange company engineering economics cost estimates, Palmer uses econometric estimates of marginal cost from 87 central offices in the New England Telephone territory. She finds the following: 1) "business-service revenues subsidize residential-service provision at nearly 65% of the suburban central offices;" 2) "almost all of the offices satisfy the sufficient stand-alone cost condition for a business-to-residential subsidy;" and 3) "the sufficient conditions for a residential-to-business subsidy fail for all 87 observations" (Palmer 1992, 415, 427, 430).<sup>52</sup>

In a study of French telecommunications Curien finds:

(A) rural line receives a yearly average subsidy of 1,400 French Francs....business lines subsidize professional and residential ones up to FF 8.5 billion....This study shows an empirical estimate of traditional expectations of subsidy from toll to local, from business to residence and from urban to rural....canceling out all trade-offs between types of services would consist in raising the rural subscriber's bill by 71% (1991, 94, 102).

Robert Albon (1991, 10) briefly reviews existing estimates of telecommunications cross-subsidies in Australia (ranging from \$200 million to \$1 billion). He suggests consideration of the full economic costs of cross-subsidization and identification of optimal subsidy levels.

Frank Kolb (1995, 3) finds that flat-rate residential basic local exchange service receives a \$2.39 subsidy per line or \$66 million annually. The existence of such an estimate is noteworthy since the shared, common, or joint costs (i.e., those not incremental to any individual services) of Bell South were estimated to represent approximately 50% of the total costs of the firm.<sup>53</sup> In general, the larger the shared costs of the provider the greater the range of subsidy-free prices and the less likely that any service will receive a cross-subsidy.<sup>54</sup>

51 See Dingwall (1995, 120) citing Telecommunications Reports (1995).

52 See also Autin and LeBlanc (1983).

53 "The incremental cost of all services provided by Southern Bell represents approximately 50% of the total cost of doing business" (Kolb 1995, 3)

54 For example, if 100% of the costs of the firm were common costs, any positive price for a service would

William Taylor (1994) finds that "BA-Maryland estimated that subsidy burden [to basic local residential service] to be \$60.3 million per year." Other studies also provide some indication of the size of the cross-subsidies that exist.<sup>55</sup>

Still other papers, while not providing estimates of the level of subsidies are germane to the issue. Vinson Snowberger (1990, 415) defines optimal levels of subsidization for flat-rate access, extraordinary terminal equipment charges, and low income support. Brennan and Palmer (1994, 115) compare the costs of cross-subsidization to the gains from competition and economies of scope for diversifying firms. Levin and Meisel (1992, 465) find cross-subsidization does not account for lower cable TV prices by telephone companies. Kahn and Shew (1987) discuss many of the policy and pricing issues germane to dealing with cross-subsidies. Lenard et al. (1992) provide estimates of stand-alone costs for postal service. Also germane to the discussion of telecommunications cross-subsidies is the extent to which lower basic local exchange prices actually advance the cause of universal service (i.e., increase penetration). Part of the economic literature suggests that low local rates do little to advance the cause of universal service because local demand elasticities are small, many potential customers fail to subscribe for non-economic reasons, and toll prices may have a greater effect on penetration than local charges.<sup>56</sup>

## 7. Loop Costs and Measures of Local Subsidy

Because of the focus on the costs and revenues of basic local exchange service in cost proxy models, rate rebalancing proceedings, the FCC access charge reform proceedings, and universal service proceedings, the proper treatment of local loop costs has become critically important. One sometimes hears of unpublished measures of cross-subsidization in which residential basic local exchange service is either not subsidized or is purported to actually provide a subsidy to other services. This result invariably is based on a misunderstanding or misrepresentation of the costs of loop facilities as shared or common costs rather than as a cost that is directly attributable to the provision of access to a modern telecommunications network.<sup>57</sup>

For a variety of reasons, analyses of loop costs are susceptible to logical error. When considered carefully and properly, it is clear that loop costs are not common production costs to the LEC.<sup>58</sup> Rather, loop costs are directly attributable to the services that cause them (e.g., private line, special access, Centrex, and the subscriber access component of basic local exchange service). Kahn and Shew (1987) first described the fallacy of considering the costs of local access as joint or common costs in the context of a discussion on six pricing fallacies. Parsons (1994) later expands the analysis of Kahn and Shew and arrives at similar conclusions. There appears to be only one article by economists, Gabel and Kennet (1993(a)),

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prevent it from receiving a cross-subsidy (assuming independent demand between the firm's services).

55 See Weinhaus (1994) discussing six studies.

56 See, for example, Hausman, Tardiff and Belinfante. (1993), Kaserman and Mayo (1994, 140), and Parsons (1996, 240-46).

57 For example, Parsons (1994, 156 footnotes 28 and 30) lists eight orders in which state commissions have stated or implied that loop costs are common production costs to the LEC.

58 See, e.g., Wenders (1987, 177-83); Kahn and Shew (1987, 191); Larson and Parsons (1995, 59); Parsons (1994, 149); Parsons (1996, 227); and Parsons (1995).

disputing the finding that loop costs are not common production costs to the LEC. However, this article induced a record three comments in response to the article in the *Review of Industrial Organization*.<sup>59</sup> It also appears that Gabel and Kennet are inconsistent in their article, at times arguing that loop costs are incremental to toll calling and at times arguing that these costs are common costs.<sup>60</sup> Kaserman and Mayo (1994, 135) conclude that "[a] review of Gabel and Kennet's article and the responses to it leads us to conclude that their argument against adoption of a two-part tariff is woefully weak on both theoretical and empirical grounds."

There are several reasons why loop costs are not common production costs of the LEC, only one (which may be the most intuitive) is treated here.<sup>61</sup> In dealing with the costs of subscriber access, it is easy to confuse the perspectives of the customer and the service provider (i.e., the LEC). Indeed, the existence of complements in consumption (e.g., toll and local access) does not indicate complementary relationships (common costs) in production; local access has a uniquely identifiable cost. Although the price paid by the customer for subscriber access may be a common cost *to the customer*, loop costs are not therefore necessarily common production costs *to the LEC* (Parsons 1994, 148, 158-9). It is certainly possible that a customer may purchase subscriber access for multiple activities. For example, consider a hypothetical firm that has two products—computer network consulting, provided locally, and personal computer software, sold internationally. All the local telephone calls made by the firm are for its computer network consulting, while all its long-distance calls are made specifically for its software products. The firm pays a monthly fee of \$30 for subscriber access and pays separate charges for local and long-distance calls. This firm may well consider the \$30 subscriber access fee to be a cost common to the provision of *its two products*, consulting and software.

A customer's use of subscriber access service and its role in the customer's cost function have no bearing on whether these costs are common or directly attributable *to the LEC*.<sup>62</sup> The cost to a LEC of providing a service is not a common cost simply because customers use the service for multiple activities.<sup>63</sup> This distinction between cost to the customer and cost to the provider is critical to a sound understanding of telecommunications costs. Without

59 See Kahn (1993, 39); Lester Taylor (1993, 21, 23); and William Taylor (1993, 15-16). Also see Gabel and Kennet (1993(b), 43).

60 See Parsons (1994, 149). See also Kaserman and Mayo (1994, 131) stating: "[f]irst, they [Gabel and Kennet] claim that technological change—specifically conversion of the communications network from analog to digital—makes customer access costs increasingly usage sensitive."

61 This is largely adopted from Parsons (1996, 227).

62 Rejecting this argument (for example, by accepting arguments that loop costs are common costs because the customer uses the loop for many things) leads to a variety of logically untenable results. For instance, a telephone company providing only a single product, subscriber access, would have its costs classified as common costs despite having no other products to share the common cost. Such faulty reasoning would lead to the conclusion that the cost to a highway department of constructing a segment of highway would be considered a common cost to butchered meats, milk, stereo equipment, and dry cleaning if each of the stores distributing these products were to use the section of highway to receive its products. Similarly, a car would be classified as a common cost to motels since they are used to drive to motels. These implications fly in the face of common sense; the premise on which they are based is simply wrong.

63 If this were true, it would lead to the peculiar result that the cost of the loop is a common cost when used to provide subscriber access to some customers, those using the service for multiple activities, but not common when providing service to other customers (such as a single-product private line customer). As customers move, the same loop would be considered common at some points in time but not at others.

proper consideration of LEC loop costs, it is impossible to properly consider the issue of cross-subsidization in telecommunications.

## 8. The Recent Key FCC Orders and Cost Proxy Models

### 8.1. Costs and the FCC Orders on Access Reform and Local Competition

In its order on local competition, the FCC (1996, paragraphs 618-862) describes in detail how the costs for unbundled network elements are to be considered and how these elements are to be priced.<sup>64</sup> The FCC (1996, paragraph 674) coined a new term "Total Element Long Run Incremental Cost" (TELRIC) and stated:

Under the third approach [the one adopted], prices for interconnection and access to unbundled elements would be developed from a forward-looking economic cost methodology based on the most efficient technology deployed in the incumbent LEC's current wire center locations. ... is compatible with existing infrastructure ... most closely represents the incremental costs that incumbents actually expect to incur in making network elements available to new entrants.<sup>65</sup>

TELRIC specifically excludes embedded costs, retail costs, opportunity costs, and revenues to subsidize other services.<sup>66</sup>

"TELRIC" has two meanings in the FCC order: one corresponding to a cost concept (discussed above); and the second representing a pricing methodology. As a pricing methodology, TELRIC refers to the long-run incremental costs of network elements as defined by the FCC plus a "reasonable allocation of forward-looking common costs" (FCC 1996, B-30, Rules Section 51.505). With regard to the "long-run" nature of the cost calculation, the economic literature on cross-subsidization is largely silent.<sup>67</sup> The economic literature in general is mixed with regard to the efficiency of short-run versus long-run marginal cost pricing.<sup>68</sup> Also, while the economic literature on cross-subsidization is silent on the specific application of forward-looking (rather than accounting or embedded costs), economists generally refer to forward-looking economic costs rather than accounting cost. The sum of the forward-looking incremental costs may fall below the total accounting/historical costs of a LEC for two primary reasons: 1) the existence of shared and common costs (i.e., the existence of economies of scope); and 2) allowed depreciation rates in the past that were too low to reflect market rates of depreciation of capital assets.<sup>69</sup> Therefore, while the literature on cross-subsidization may ignore embedded costs, the second source of differential (depreciation) has equity implications and implications for dynamic efficiency as new investors consider the regulatory agencies' records for establishing rules that allow for the

64 However, these sections of the order were largely vacated by the U.S. Court of Appeals for the Eighth Circuit (1997).

65 See FCC (1996, paragraph 685).

66 See FCC (1996, B-30, Rules Section 51.505).

67 Discussions of adding or deleting a product or service would, however, seem to imply a long-run cost standard. Baumol (1987, 117-9) explicitly recommends a long-run standard. Also, incremental cost calculations by LECs are almost exclusively of the long-run variety.

68 See Parsons (1994, 166 footnote 74) for a listing of the articles on both sides of the long-run/short-run debate.

69 See Crew and Kleindorfer (1992) for a discussion of the effects of rates of depreciation for regulated firms which are too low.

investments.

s (1996) suggested use of a "reasonable allocation of forward looking joint and costs" is not supported by the economics literature on cross-subsidization or by the economic literature generally.<sup>70</sup> Demand information is explicitly excluded from the FCC's methodology for establishing prices that diverge from incremental cost in favor of joint and common costs.

Parties petitioned the U.S. Court of Appeals (8<sup>th</sup> Circuit) to review the FCC's Local Competition Order. The petitioning parties objected to the Order on a variety of grounds including a lack of jurisdiction by the FCC, the potential for confiscation of property, and unclear rules for determining costs and establishing prices. The U.S. Court of Appeals for the Eighth Circuit initially granted a temporary stay of the FCC's Order in October 1996, and issued a final opinion in July (1997). The FCC's (1976) discussions of TELRIC and its treatment of cost and pricing issues were largely vacated by the U.S. Court of Appeals for the Eighth Circuit (1997(a)). However, these sections of the FCC's Order were vacated by the Eighth Circuit Court's opinion, on the basis of lack of jurisdiction.<sup>71</sup> Therefore, the appropriate determination of cost and pricing methodologies for unbundled network elements, interconnection services, and the resale of retail services was left to be determined by the states.<sup>72</sup>

It appears that the FCC's orders do not provide for the existence of a standby or default capacity charge to compensate for the costs of the continued carrier of last resort obligations to incumbents. Therefore, the opening of the local exchange market to competition through the sale of unbundled network elements, resale, and interconnection may create an avenue for a new form of cross-subsidization. Over time, customers who receive only "standby" service from the incumbent may be subsidized by those customers who actually purchase revenue-generating service from the incumbent.<sup>73</sup>

The FCC order on access charge reform (1997(b), paragraphs 28-31) discusses "implicit subsidies in the existing system." The order fundamentally changes the recovery of the non-traffic sensitive (loop) costs of the LECs that have been allocated to the interstate jurisdiction. In the past, interstate switched access charges provided the great majority of the contribution to recover the costs of the local loop that were allocated to the interstate jurisdiction. The order establishes a significant reduction in interstate switched access charges. These reductions in switched access charges will be offset, in part, by increases in the subscriber line charge (a charge per line to the end user) for multiline business lines and for additional residential lines, as well as through the introduction of a Presubscribed Interexchange Carrier Charge (PICC).<sup>74</sup> While the access charge reform order does not discuss cost methods in detail, as occurred in the local competition order, forward-looking incremental cost concepts are still embraced.

70 See, for example, Parsons (1996, 233) citing twenty-four articles from the economics, legal, and managerial accounting literature regarding the disadvantages of cost allocations.

71 U.S. Court of Appeals for the Eighth Circuit (1997). "Having concluded that the FCC lacks jurisdiction to issue the pricing rules, we vacate the FCC's pricing rules on that ground alone and choose not to review these rules on their merits."

72 On October 14, 1997 the U.S. Court of Appeals for the Eighth Circuit (1997(b)) denied a petition for rehearing and ruled that ILECs were not required to recombine unbundled network elements.

73 See Weisman (1988) for a discussion of standby or default capacity charges.

74 The PICC will be recovered by the IXCs through whatever mechanism they choose.



## 8.2. Revenues and the FCC Universal Service Order

As required by the Telecommunications Act, the FCC (1997(a)) released its order regarding universal service on May 8, 1997. Part of the order deals with "support" for telecommunications services to low-income consumers, schools and libraries, and rural health care providers (FCC 1997(a), paragraphs 326-738). For ease of discussion, call this "non-high cost" support. The order does not require a specific determination of the existence or the size of a cross-subsidy for these non-high cost purposes. Rather, the support mechanisms reflect specific dollar reductions in customer's bills (for low income customers), a percentage reduction in existing telecommunications prices (for schools and libraries), or a rural price, for the functional equivalent of the urban service, that is no greater than the urban price (for rural health care providers).

In contrast, support for rural, insular, and high cost areas requires a specific determination of the forward-looking incremental costs of providing universal service (FCC 1997(a), paragraphs 199-325). In addition, the order states: "[w]e .. intend to establish a nationwide benchmark based on average revenues per line for local, discretionary, interstate and intrastate access services, and other telecommunications revenues that will be used with either a cost model or a cost study to determine the level of support carriers will receive for lines in a particular area" (FCC 1997(a), paragraph 259). While the FCC did not determine a specific national revenue benchmark, it did state that "... it appears that the benchmark for residential services should be approximately \$31 and for single-line business should be approximately \$51" (FCC 1997(a), paragraph 267).

However, the "benchmark," or revenue side of the FCC's test for high-cost support, includes revenues from services that are beyond the scope of the definition of universal service.<sup>75</sup> The FCC's high cost support mechanism does not embody a gross incremental cost test; there is a fundamental mismatch between the revenues considered by the FCC and the costs considered. Similarly, the high cost support mechanism does not readily embody a net incremental cost test. While there are likely strong complementary effects between local access and other services, the FCC's method includes all of the revenues from a broad array of services purchased by residential (or single-line business) customers as measured by a national average. The FCC's high-cost support mechanism fails, in two ways, to meet the economic standard for evaluation of a cross-subsidy. First, as discussed above, the revenues and costs are mismatched; revenues are included for services not included in the definition of universal service. Such a method fails to provide explicit support for those customers that do not purchase a national average level of toll and other discretionary services.<sup>76</sup> This method retains part of the pattern of implicit cross-subsidies within classes of customers (e.g., toll-to-local and urban to rural). It does, however, eliminate business revenues from the calculation.

Second, a national average revenue benchmark will be compared to the costs that are incurred at very small levels of geography (which will be discussed in detail later in this

75 Universal service is defined to include voice grade access to the public switched network, single party service, Dual Tone Multifrequency (DTMF) signaling, single party service, and access to: 911, E911, operator services, interexchange services, directory assistance, and toll limitation for low-income customers (FCC 1997, paragraph 22).

76 For example, the proposed \$31 national benchmark is irrelevant to a customer spending \$18 for basic local exchange service but purchasing no other telecommunications services.

section). Portable (between incumbents and qualifying new local competitors) universal service funding will also be determined at geographic levels no larger than individual wire centers. This creates a mismatch as these geographically-specific costs are compared to revenues based on national averages.

### 8.3. Cost Proxy Models

In recent years, alternatives to LEC incremental cost models have been developed, often under the general description of "cost proxy models."<sup>77</sup> These models were generally developed because of an interest in measuring the incremental cost of basic service for high cost areas. Because of the interest in costs for specific high cost areas, these models have tended to focus at relatively small geographic levels. The RAND Model was perhaps the earliest of the models and was initially populated with detailed data for California.<sup>78</sup> An early version of the Hatfield Model considered the costs of universal service in a "scorched earth" environment in which the entire network is assumed to be built from scratch, even changing the locations of wire centers (Hatfield Associates, Inc. 1994). More recent proxy models include the Benchmark Cost Model (BCM),<sup>79</sup> BCM2,<sup>80</sup> the Cost Proxy Model (CPM),<sup>81</sup> the Hatfield Models (HM),<sup>82</sup> the Telecom Economic Cost Model (TECM),<sup>83</sup> the Local Exchange Cost Optimization Model (LECOM),<sup>84</sup> and the Benchmark Cost Proxy Model (BCPM).<sup>85</sup> The BCM and a version of the Hatfield Model were considered in the FCC's Interconnection Order to apply six existing state orders to all states in the form of loop cost proxies (FCC 1996). The two models identified by the FCC in its universal service order for further consideration are the Hatfield Model and the BCPM.

The incremental cost studies produced by local exchange companies (LECs) generally rely on company-specific information and reflect the costs of a specific company providing service. Often some portion of the inputs utilized by LECs are proprietary and the estimated results may be held confidential and proprietary as well. In contrast, a proxy model generally relies upon public domain data and produces results that are nonproprietary.

The BCPM and the Hatfield Models are similar in some respects.<sup>86</sup> Both utilize public domain data on residential populations and business locations. They also rely on public information from the US Geologic Survey data bases regarding terrain characteristics and model some geographic areas as if they were square in shape. Each model has a large number of inputs, many of which are adjustable by the user.

There are several important distinctions between the current versions of the models (HM 4.0 and BCPM 2.0).<sup>87</sup> First, the BCPM 2.0 utilizes much smaller census block (CB) data

77 See Cole (1997) for a more detailed discussion of the models and their history.

78 See Mitchell (1990) and Cole (1997).

79 Originally sponsored by Sprint, NYNEX, USWEST, and MCI.

80 Sponsored by Sprint and USWEST.

81 Sponsored by Pacific Bell and INDETEC International.

82 Currently sponsored by AT&T and MCI.

83 Sponsored by Ben Johnson & Associates. See Johnson (1997).

84 See Gabel and Kennet (1994).

85 This is the result of a "best of both" attempt to merge the BCM2 and the CPM (currently sponsored by Sprint, U S WEST, and BellSouth).

86 See Benchmark Cost Proxy Model (1997) and Hatfield Model Release 4.0 (1997).

87 See for example, BCPM Sponsors Joint Comments (1997) and Hatfield Model Sponsors Ex Parte (1997).

rather than the census block group (CBG) data utilized by the HM 4.0.<sup>88</sup> Second, the BCPM 2.0 creates "variable" grids based on CB data that vary to reflect standard engineering criteria and population locations, while the HM 4.0 adjusts network characteristics to reflect the CBG. Third, the two models make significantly different modeling assumptions in low density areas. The HM 4.0 assumes a large proportion of the population (approximately 85%) are clustered on 3-acre lots in four towns per CBG. The BCPM 2.0 uses data on the road network to model population location (assuming that customers are located within 500' of roads). Fourth, the HM 4.0 uses a specific switching cost module, while the BCPM relies on national average data for switching and transport costs. Fifth, the BCPM 2.0 has greater specificity in reflecting terrain data including water bodies.<sup>89</sup>

Distinctions occur in the default inputs as well as the model algorithms. The important inputs in the models include: the cost of money; rates of depreciation by type of facility; prices for switching equipment; prices for pair gain/digital loop carrier (DLC) electronic equipment; the proportion of forward looking joint and common costs; and the proportion of distribution structure (poles, conduit, trenching) that could be shared with other utilities (e.g., electric power, cable, gas, new telecommunications competitors). However, many of these inputs can be adjusted by the user.

In reporting to the FCC, the State members of the Federal-State Joint Board on Universal Service conclude: "The State members recommend that the FCC select the Benchmark Cost Proxy Model (BCPM), sponsored by Sprint, US West, and Pacific Bell for further analysis and refinement, with the objective to be the BCPM's use in determining the amount of support to be received by local exchange carriers for serving high cost areas" (McClure et al. 1997, 8).<sup>90</sup> However, the FCC did not accept the State Board's recommendation to choose the BCPM and reject the Hatfield Model. Rather, the FCC decided not to choose a proxy model at this time (FCC 1997(a)), extending the period of competition between the models. Even disregarding testimony in regulatory proceedings, a great deal has been written (although generally not yet published) regarding these models.<sup>91</sup>

Both the BCPM and Hatfield Models find costs of basic exchange service well in excess of likely revenues for lower-density rural areas. These models provide strong support that basic local exchange service for residential customers is cross-subsidized in low density areas.

The BCPM and Hatfield Models continue to change. Plans for the HM 5.0 include a greater reliance on geocoded customer locations and/or CB data. Plans for the BCPM 3.0 include specific calculations for unbundled network element costs and specific modules for switching and transport costs.

Certain issues should be considered when utilizing proxy models or proxy model cost estimates. Cost proxy models generally attempt to estimate the least cost method of providing service in a specific geographic area. These models do not attempt to reflect the embedded

88 There are approximately 226,000 CBGs covering the United States. On average, a CBG contains 31 CBs.

89 The Hatfield model employs a loop distance multiplier for more difficult terrain (simply assuming a longer loop) rather than directly reflecting higher costs for more difficult terrain (McClure et al. 1997, 8).

90 It appears that the decision was based in part on the BCPM's more detailed treatment of terrain, cable gauge, and load coils.

91 See, for example, Atkison, et al. (1997); Baldwin and Selwyn (1997); Christensen Associates (1997); Duncan, et al. (1997); Gabel and Shifman (1997); Gabel (1996); McClure, et al. (1997); Duffy-Deno et al. (1997).

costs of providers or the forward-looking costs of any particular provider. Generic cost estimates, rather than estimates of the costs of a specific regulated provider, may not comport with some forms of regulation or with traditional regulatory covenants with respect to allowing the incumbent a reasonable opportunity to recover its prudent investments. Also, some notions of "least cost" provision of service do not correspond to the costs that will be incurred by the long-run marginal provider in an effectively competitive market. In a market where firms do not have identical costs, it is the cost of the marginal provider, rather than the least cost provider, that determines market prices.<sup>92</sup>

## 9. Summary and Conclusion

While the term "cross-subsidy" has a long history in general usage, including discussions of a method of financing predatory pricing, the concept was not formalized until the work of Faulhaber (1975). Two tests, the incremental cost test and the stand-alone cost test, were developed in a formal game theoretic context at the level of products or services. This concept was expanded through consideration of coalitions of consumers, consistency with demand functions, opportunities for side payments, relaxation of a zero profit constraint, and sustainability.

Several factors must be considered in order to apply the literature on cross-subsidization to the telecommunications industry. The assumptions of zero economic profits and efficient production may not apply under rate-of-return regulation or price-cap regulation. Cross-elastic effects will cause the standard tests for cross-subsidy to become either a necessary but not sufficient condition (in the presence of net substitutes), or a sufficient but not necessary condition (in the presence of net complements) for subsidy-free pricing. In practice, not all combinations of service costs are tested; however, the single-service incremental cost test can still serve as a necessary condition (with independent demands) to preclude a service from receiving a cross-subsidy.

The economics and trade literature is replete with statements claiming the existence of cross-subsidies in telecommunications. These statements generally describe four patterns of cross-subsidization: 1) toll to local; 2) business to residence; 3) low usage to high usage; and 4) urban to rural. Statements regarding the existence of these cross-subsidies appear in the literature regarding telecommunications in both the United States and other countries. Cross-subsidization of basic local exchange service has received the greatest attention and estimates of the magnitude of this subsidy were reviewed. The improper consideration of loop costs has often confused discussions of cross-subsidization. Loop costs are not common production costs to the LEC.

The three recent key decisions of the FCC (on local competition, universal service and access charge reform) make proper consideration of cross-subsidies more important. All three orders embrace forward-looking economic costs rather than embedded costs. However, the TELRIC pricing methodology described in the FCC (1996) local competition order fails to satisfy the economic standard for a cross-subsidization test and excludes the necessary

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92 See, for example, Coll and Holahan (1983, 221) stating: "[w]hen firms have different costs, they have different entry and exit prices. Thus the industry's long-run equilibrium can coexist with positive economic profits for the inframarginal, low-cost firms."

demand information to approximate second-best pricing. Similarly, the FCC's (1997(a)) universal service order fails to establish a proper standard for testing for cross-subsidies. The FCC's method compares revenues from a broad array of services to the costs of only a subset of those services.

Proxy models, notably the Hatfield Model and the Benchmark Cost Proxy Model, have received a great deal of attention in the industry of late. These models utilize public domain data on households, businesses, terrain, and road networks to estimate the costs of basic local exchange service at a relatively small geographic level (e.g., the census block group). The two models are similar in some respects but differ significantly in their treatment of low density areas, use of terrain data, assumptions regarding long loops, and their default values for user-adjustable inputs. Both the BCPM and the Hatfield Model find costs of basic exchange service well in excess of likely revenues for lower-density rural areas.

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